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Rope-like structure

The invention relates to a rope-like structure as claimed in claim 1.

US 4,640,178 discloses a core rope which combines a host of core fiber bundles as a core and which is surrounded by an intermediate jacket. Around the intermediate jacket is a braided, outside jacket of monofilament yarn. The core, intermediate jacket and jacket are not connected among one another and therefore slip mutually; this is disadvantageous in use of a core rope.

US 4,170,076 discloses a core rope consisting of a braided core which is formed for its part by a host of core fiber bundles. The core is likewise surrounded by a braided jacket. The core and jacket are not connected between one another and thus are not slip-proof. In use, thickened and thinned areas form; this is disadvantageous.

WO 03/027383 discloses a rope-like structure, especially core ropes, cords and ropes, in which the individual fibers, yarns or yarn strands are connected among one another such that they are mutually slip-proof. These rope-like structures have increased strength in stretching behavior and increased knot strength.

AT 358433 discloses a rope, especially a mountain-climbing rope, in a core-jacket construction in which the jacket threads are guided such that they lie as a braided pattern colored to the outside or lie on the core to the inside for better holding of the jacket. The core yarns are held by tubular braidings.

Furthermore, ropes with a core and a jacket or cords are known which are conventionally twisted or produced from different braided strands as hollow braiding without a

core or from strands. In this way tubes can be formed with these cords on one end with so-called "splicing". These properties are valued and used mainly in sailing. But splicing is complex and thus expensive.

Strings or thin cords are known as strings in a tennis racket; they are plaited round as a core with a fine yarn in order to obtain greater friction and strength. Likewise strings and fine cores are known which have a ribbed surface ('longitudinal-traverse' pattern) or another special structure to increase friction.

The object of this invention is to propose a rope-like article or rope-like structure in which the individual fibers, yarns or yarn strands are connected as longitudinal fibers among one another such that the fibers, yarns, or yarn strands are present mutually slip-proof, by which the aforementioned disadvantages are eliminated.

As claimed in the invention, this object is achieved with a rope-like structure according to the wording of claim 1.

The invention is detailed below using the figures.

Figure 1 shows a schematic structure of a core rope as claimed in the invention

Figure 2 shows the schematic structure of a cord as claimed in the invention

Figure 3 shows a cord with reversed, additional traverse fibers

Figure 4 shows cords with additional traverse fibers guided from the inside to the outside and from the outside to the inside

Figure 5 shows cords with at least one high-strength longitudinal fiber

Figure 6 shows a first embodiment of a core with several traverse melt fibers

Figure 7 shows a second embodiment of a core with several parallel fibers in

longitudinal direction

Figure 8 shows a third embodiment of a cord with outside melt fibers

Figure 9 shows a first embodiment of a core rope with an intermediate jacket and traverse additional fibers

Figure 10 shows a second embodiment of a core rope of the same materials of differing thickness and strength

Figure 11 shows a schematic structure of a low-stretch rope

Figure 12 shows a first embodiment of a rope with good damping properties

Figure 13 shows a rope with lettering

Figure 14 shows a rope with continuous marking

Figure 15 the schematic structure of a climbing rope

Figure 16 shows a rope with a cavity

Figure 17 shows a rope with a change of cross section

Figure 18 shows a rope-like structure with openings

Figure 19 shows a rope-like structure with looped-back end

Figure 20 shows a part of a rope-like article with cross sections

Figure 21 shows a cord with openings arranged in a grid for low-slip stringing

Figure 22 shows a cord with thickened areas arranged in a grid for low-slip strings.

Figure 1 shows the schematic structure of a core rope as claimed in the invention. The core rope 10 has an inner core area 1 and a jacket area 2 which surrounds it. The core area 1 consists of at least one core 3 which is for its part formed from a host of fibers, yarns, yarn strands and/or at least one cord as claimed in the invention, and which are all designated as a so-

called core fiber structure 5 below. The jacket area 2 consists of a jacket 4, which for its part is formed from a host of fibers, yarns, yarn strands and/or at least one additional cord as claimed in the invention, and which are all designated as a so-called jacket fiber structure 6 below. In the core area 1 there can also be several cores, for example three or five, provided with core fibers and/or cores as claimed in the invention of the same or different type, with which the diversity of the core fiber structure 5 is shown. The similar also applies to the jacket fiber structure 6.

Core fiber structures 5 and jacket fiber structures 6 consist of longitudinal fibers and are combined below as longitudinal fiber structures 40.

A portion of the core fiber structure 5, called core fibers 5', is present in the jacket area 2 and is connected in it to the jacket fibers of the jacket fiber structure 6, while a portion of the jacket fiber structure 6, called jacket fibers 6', is present in the core area 1 and connected in it to the core fibers 3. In this way the jacket is attached to at least one core mutually slip-proof. Several jackets with the most varied fibers can also be connected mutually slip-proof to at least one core. At least one other fiber 50 which lies essentially transversely to the longitudinal fiber structure 40, or a fiber bundle holds the longitudinal fibers in the longitudinal fiber structure 40 unable to slip against one another, or mutually together. Furthermore the expression 'fiber 50' also always means a fiber bundle below.

The fiber 50 to the longitudinal fiber structure 40 is essentially transversely diagonal to the longitudinal fibers and runs at almost any angle to them, but generally however at an angle which is less than 45°. But it can also be an angle from 45° to 90° or exactly 90°. Special arrangements of the fiber 50 are described below.

Slipping of the jacket on the core is a known, but highly undesirable property in core

ropes, as already described. The described structure, on the one hand with mixing of core and jacket fibers and on the other hand by binding to traverse fibers, prevents any slippage and therefore offers important advantages.

Advantageously it runs uniformly when running over carabineers, rollers, and rope dispensers. Neither thickened sites nor thin sites occur, as is conventional in jacket slippage. These core ropes can be used in place of twisted ropes.

The fibers can be materials such as PBO, polyolefin, polyamide, polyester, Dyneema, Aramid, Vectran and Zylon for high-strength applications, Aramid, Nomex and monofil yarns for heat-resistant and flame-resistant applications, polypropylene, polyamide, polyester and monofil yarns for UV-resistant, polypropylene monofil yarns for floating applications, and polyamide, polyester and monofil yarns for cut- and shear-resistant applications.

Traverse fiber bundles consist of monofil, multifil or staple fibers. They are twined, twisted or processed as parallel fiber bundles. Mixed fibers of different fibers are also used. Any combination of individual fibers is conceivable.

Figure 2 shows the schematic structure of a cord as claimed in the invention. The cord 20 has a longitudinal fiber structure 40 made from fibers, yarns, and/or yarn strands. The individual yarn strands are surrounded or bound with at least one other fiber 50 or a fiber bundle. It lies roughly transversely to the longitudinal fibers. The connection of the longitudinal fibers by means of the other fibers 50 is made such that it runs in the traverse direction, diagonal direction or some other selected angle to the longitudinal fibers.

Under the longitudinal fibers there is at least one longitudinal thread, or a longitudinal fiber 41 which is surrounded or enclosed by the fiber 50, the longitudinal thread or the

longitudinal fiber 41 being held at a certain position within the longitudinal fiber structure 40. The fiber 50 is routed back after this position such that it surrounds other individual longitudinal fibers of the longitudinal fiber structure 40 individually, partially or entirely, and holds them in position, or holds them essentially stationary among one another without the capacity to slip or move.

The primary function of the fibers 50 or of the fiber bundle lies in this binding process. Of course the same fibers after "binding" can be routed further to the next binding site, for which the fiber generally runs parallel to the longitudinal fibers; this is equivalent to "offset" of the binding points. This continued routing of the fibers 50 is a secondary function; for this reason the designation 'essentially traverse" seems appropriate. With this one or several fibers 50 a surface which appears differently is formed or achieved. The individual yarn strands and fibers which are used for this purpose and which can be different in thickness, strength, and color are connected essentially immovably to the longitudinal fibers of the longitudinal fiber structure 40.

A cord of this type looks similar to a conventional, twisted core, but can also have different materials and does not unravel or is resistant to unravelling; this is a major advantage. Likewise it can be produced such that it looks similar to a braided cord. It can consist of different fibers which are immovably connected against one another, but has higher strength with respect to a braided cord.

Figure 3 shows a cord 20 with a further traverse fiber 50 placed around the longitudinal fibers of the longitudinal fiber structure 40. The fiber 50, lying outside, surrounds one of the longitudinal fibers 41 at at least two points, in order to then be guided away or back in the

direction of the core center from the outer surface of the cord, and in order to later reach the surface again between two longitudinal fibers and to surround another longitudinal fiber 41' or to be "wrapped" around it. The fibers 50 can be of different strength and extension. Some of the longitudinal fibers are made as so-called melt fibers which are melted with heat. Elastically made fibers are likewise used.

Figure 4 shows a core 20 with another traverse fiber 50 guided from the inside to the outside and from the outside to the inside. The fiber 50 runs over a larger part of the cord surface and is wrapped around the longitudinal fiber 41.1 of the longitudinal fiber structure 40, routed to the inside, wrapped around the longitudinal fibers 41.2 and 41.3 and routed to the outside to the surface of the cord in order to be routed again around the longitudinal fibers 41.1. The latter however takes place around the reverse direction. Each of the outside longitudinal fibers can assume the role of the longitudinal fibers 41.1 with respect to "wrapping". The choice of the next longitudinal fibers can take place in a strict sequence as the next or according to any, even stochastic pattern. The same applies to the choice of one of the inside longitudinal fibers 41.2 or 41.3, or one of the core fibers.

In this way the core fibers and the fibers and/or the yarn strands which form the jacket area are especially strongly bonded. A different stiffness or flexibility of the cords can be achieved in almost any way. Such a core is resistant to unravelling when cut.

Figure 5 shows a cord with at least one high-strength longitudinal fiber. A cord 20 under the longitudinal fibers of the longitudinal fiber structure 40 has at least one other longitudinal fiber, or longitudinal thread 41, 41' which has much higher strength than the remaining longitudinal fibers. In this way extremely low stretching of the rope-like structure can be

achieved. At the same time, the longitudinal threads 41, 41' form one or more sites 42 or areas within the longitudinal fiber structure 40 which have a much higher density and strength, by which also especially strong, reliable sewing 43 is enabled with low sewing loss. Moreover the sites 42 have less stretching.

Figure 6 shows a first embodiment of a cord with several traverse fibers, or fiber bundles. A cord 20 has several traverse fibers 50 to the longitudinal fibers of the longitudinal fiber structure 40 or yarn strands. Under the longitudinal fibers of the longitudinal fiber structure 40 there is at least one longitudinal thread 41, 41' with much higher elasticity and/or extension at at least one location within the longitudinal fiber structure. For this reason such a cord acquires special elasticity and ease of bending.

The longitudinal fibers consist of polyester, the traverse fibers of polyamide. Each of the outside longitudinal fibers is surrounded every 0.3 - 1.5 mm by a fiber 50 or is bound by it.

Such a cord 20 is characterized by higher stretching and/or elasticity. The damping properties of such a cord are especially high. This is the case especially when it is worked into a dynamic rope as one of the core cords. In this connection cords are processed as a "finished product" or as a longitudinal yarn, longitudinal cord or longitudinal fiber structure into a core rope.

Figure 7 shows a second embodiment of a cord with several parallel fibers in the longitudinal direction. A cord 20 under the longitudinal fibers of the longitudinal fiber structure 40 has at least one other longitudinal fiber 44 which are present as so-called melt fibers in the core and/or in the jacket. The traverse fibers 50 are present here partially likewise as melt fibers 51 of polyamide. The longitudinal fiber structure consists of polyester in addition to these melt

fibers. In heat, i.e. during heat treatment in the course of the production process or after it, these fibers melt at several locations 45 with the longitudinal fibers, by which much higher abrasion resistance of the individual fibers or yarn strands among one another or in the jacket area is achieved. In this connection the melt fibers 44 and 51 fuse with the other longitudinal fibers at sites 45. Moreover, the longitudinal fibers are present slip-proof after fusion. This results in much higher impregnation (for example with polyamide) and/or coating (polyamide).

Figure 8 shows a third embodiment of a cord with outside melt fibers. A cord 20 under the longitudinal fibers of the longitudinal fiber structure 40 has other outside longitudinal fibers 46 which are made as melt fibers of polyamide PA 6 or polyamide PA 6.6 (Griion, Ems-Chemie, CH-7013 Domat/Ems). This yields an especially abrasion-resistant but flexible jacket after processing (among others, heat treatment). Other traverse fibers 50 are polyamide (melt fibers PA 6) which bind the longitudinal fibers every 2 mm in alternation.

The resulting cord properties are extremely high abrasion resistance and improved UV resistance. These cords can be used in rollers, winches, carabineers and clamps and have improved abrasion resistance.

One structure of a cord as described in Figure 8 can also apply to a rope. In more general form the core and the jacket have the same or different longitudinal fibers of the longitudinal fiber structure 40. The outside longitudinal fibers 46 are made at least partially as melt fibers. One at least additional traverse fiber 50 surrounds the outside longitudinal fibers 46 or binds them. At the same time, at least one second additional traverse fiber 50' is present as a melt fiber which surrounds the outside longitudinal fibers 46, or binds them. Melting of the longitudinal fibers 46 with the second additional traverse fiber 50' yields a fused jacket.

Figure 9 shows a first embodiment of a core rope with an intermediate jacket and traverse additional fibers.

The core 3 has high-performance fibers in the core fiber structure 5 with fibers like polyamide (PA), polyester (PES), low-stretch polyester (PEN), Aramid, Dyneema, Vectran or Zylon. The intermediate jacket 8 consist of so-called damping yarns such as monofil or elastic yarns which have a high compression property, while the jacket 4 consist of jacket fibers in a jacket fiber structure 6, such as polyester or polyamide, which have high abrasion resistance, cutting resistance or edge strength.

The high-performance fibers of the core fiber structure 5 and the jacket fibers of the jacket fiber structure 6, also called longitudinal fibers of the longitudinal fiber structure 40, are covered or looped by additional roughly traverse fibers 50, some fibers 51 as entirely outside surrounding the longitudinal fibers, while other fibers 51' surround the longitudinal fibers only in alternation, i.e. only every other outside longitudinal fiber is bound. Polyamide was used as fibers 51, 51'.

When at least one other fiber 50 has higher strength relative to the longitudinal fibers of the longitudinal fiber structure 40 and loops and binds the longitudinal fibers differently, a rope is formed with higher bending strength and strength and thus higher stiffness.

If the core consists for example of high-strength Aramid fibers and one or in any case several jackets of heat-resistant Nomex fibers, the core rope is especially well suited for rescue applications as heat-resistant rope in firefighting and in the military.

Mixing or connection of the core fibers in at least one jacket area can be low, i.e. less than 3%. Here there need not be mixing of jacket fibers in the core area at the same time. But if

this is the case, it is likewise considered low mixing, i.e. it is less than 3%. Core fibers are then in at least one jacket area, while jacket fibers are present connected in the core area. This applies mainly to applications of currently used static and dynamic core ropes.

Figure 10 shows a second embodiment of a core rope of the same materials of different thickness and strength. A core rope has longitudinal fibers 40, the outside jacket fibers being thicker than the core fibers. The outside jacket fibers are bound with the other fibers 50 in alternation. This yields higher strength in the jacket area. The rope can also have a surface which is similar to a twisted rope. Core and jacket fibers consist of polyester and the traverse fibers consist of polyamide.

The longitudinal fibers of the longitudinal fiber structure 40 are generally present mixed as core and jacket fibers, the jacket fibers forming part of the core and the core fibers forming part of the jacket. They are at the same time bound by at least one other fiber 50 with higher strength with respect to the longitudinal fibers, the other fibers having a different thickness, strength or extensibility.

Figure 11 shows the schematic structure of a low-stretch rope. The rope consists of individuals fibers, yarns or yarns strands as longitudinal fibers of the longitudinal fiber structure 40, which are present or connected among one another such that the fibers, yarns or yarn strands are mutually slip-proof. At least one other traverse or crosswise running fiber 50 or fiber bundle binds the longitudinal fibers again and again, by which the longitudinal fibers are held mutually immovably, or stationary. In appearance it looks similar to a twisted or braided rope, but it has strength which is at least 10% higher in stretching behavior and knot strength at least 10% higher than conventional ropes. One positive property consists in that on the cut end it does not

unravel or fringe. In this rope structure as many yarns as possible are present parallel or are additionally oriented or prestretched.

In these applications the fibers in the core area should be externally parallel and are partially prestretched, while the fibers in the jacket area are arranged looping and thus are more flexible and resistant to abrasion and cutting and thus also greatly increase UV resistance.

If at least one other fiber 50 has higher elasticity relative to the longitudinal fibers of the longitudinal fiber structure 40 and if it binds the longitudinal fibers, for a core of high-strength Aramid fibers and a jacket of heat-resistant Nomex fibers or abrasion-resistant, cut-proof and/or flame-proof, heat-resistant, acid-resistant or UV-resistant fibers and/or yarns, a typical firefighting rope results. Other typical applications can be found generally in rescue applications as a rope instead of steel cables, as a load rope with little alternate bending or as a replacement of twisted ropes.

But if the core has extremely high-strength fibers which are partially oriented or prestretched, and the jacket consists of UV-resistant, abrasion-resistant and cut-resistant yarns and/or fibers, typical properties of a sailing sheet arise.

Figure 12 shows a first embodiment of a cable with especially fall-damping properties.

A rope can also be produced claimed in the invention to be as fall-damping as possible from yarns which consist of as many fibrils as possible and form a cord 20 as claimed in the invention, the core fiber structure being looped repeatedly with at least one other fiber 50 or a fiber bundle. Thus, for example a host of fibers 50, different in material and properties, can be used to surround one or more of the cores according to any pattern.

These cords as claimed in the invention are used in the core of a rope as claimed in the

invention. Due to the good damping properties achieved, this structure is preferably suited for dynamic mountaineering ropes. Due to the good fall-damping properties here mainly yarns of polyamide, polyester or POY yarns are used.

Figure 13 shows a rope with lettering. In a longitudinal fiber structure 40 by means of at least one additional fiber 50 or a fiber bundle lettering 52 has been worked into the outer surface of the structure continuously in the lengthwise direction of the rope. Good readability is greatly supported by a skillful choice of colors of the fibers 50 and/or individual longitudinal fibers.

In addition to lettering, there can be marking of any type and/or for example center marking of the rope. This working can also take place in the traverse direction or at any angle to the longitudinal direction of the rope.

Figure 14 shows a rope with continuous marking. In the longitudinal fiber structure 40, by means of at least one other fiber, continuous marking 53 has been worked into the outer surface of the structure of the rope. This is for example ring marking with continuous numbering. The surfaces of the intervals 54', 54" between the markings are identified like the markings 53 with a special choice of fibers 50 on the one hand and on the other by corresponding working into the structure of the surfaces. Thus, for example the surface of the interval 54' appears crosshatched and that of the interval 54' with broken lines lengthwise. This configuration of the rope surface is advantageous and especially user-friendly.

Figure 15 shows the schematic structure of a sailing sheet or an extremely static high-performance rope. Ropes which are similar in appearance to braided, twisted ropes or similar construction or design are produced instead of conventional core-jacket constructions of static high-performance ropes with extremely low stretching so that the extremely high-strength, high-

performance fibers in the core are very parallel and have much reduced extension and higher tearing resistance, and thus static properties are improved even with the same or reduced diameters. These longitudinal fibers of the longitudinal fiber structure 40 can be prestretched or predrawn. The fibers of the jacket can yield considerably more abrasion-resistant, less moisture-sensitive and more cut-resistant properties, the core 3 and jacket 4 being connected to one another by one or more threads or other fibers 50 which run in the other direction, such that even with the most varied fiber properties there is no jacket slip or additional stretching.

Figure 16 shows a rope with a cavity. A longitudinal fiber structure 40 in the core 3 has very high-strength, high-performance fibers with a much reduced stretching and higher tearing resistance which yield improved static properties even for the same or reduced diameters. These core fibers surround a cavity 55 which lies in the center of the core. The longitudinal fibers of the core, intermediate jacket and jacket are connected to one another by at least one other traverse fiber 50 such that jacket slip does not occur even with the most varied fiber properties. The intermediate jacket consists of different or the same fibers as those of the core or jacket. This yields a soft-flexible structure which allows formation of a damping cushion or an air cushion under the jacket, and paired with abrasion-resistant, edge-strong, cut-proof fibers and fiber structures of the jacket has extremely improved edge strength. The fiber structure of the intermediate jacket has fine-structured, extremely small cavities or extremely small air bubbles. The cavity 55 is also called a "soft core middle point'. The construction claimed in the invention is similar in appearance to braided ropes. Such a rope is especially cut-proof and is also especially well suited to rescue applications of any type.

Figure 17 shows a rope with a change of cross section. A rope with an essentially round

cross section 61 during the production process at at least one site 62 changes the cross section 63 to an oval or flat shape. At this point the rope can be for example better attached, sewn or clamped more easily. The cross section can change one time or repeatedly. Thus the oval shape can pass for example into a flat shape and later again into a round shape. The traverse fibers 50, or fiber bundles repeatedly bind the longitudinal fibers so that the rope seems surrounded by them in the manner of a net.

Cords and ropes of this type can be sewn and need not be spliced; this is a great simplification in fabrication for end connections.

As claimed in the invention, ropes can also be produced which are similar in appearance to a turned rope and in the core area consist of other extreme high-loading fibers such as high-strength Aramid fibers or Vectran, Zylon. The protective jacket can consist of fibers and/or yarns which form UV protection or an especially abrasion-resistant jacket. At the cut site this rope can be sewn and therefore need not be spliced. Moreover this rope does not unravel at the cut site. The embodiments of these core ropes are extremely diverse and cannot be definitively enumerated here.

Figure 18 shows a rope-like structure, a cord or a rope which have openings 64, 64', 64" with slot lengths L in a predefined grid with spacing d. If the slot length L is roughly 3.5 times the diameter D of the undivided rope-like structure which is present braided as a 'one-piece', an especially advantageous arrangement arises. It becomes possible to loop back the one-piece through the openings 64, by which one loop is formed on one end of the rope-like structure. Repeatedly looping back under tension yields compaction of the loop, the loop no longer be able to open, similarly to a spliced end. The grid can however also be selected arbitrarily, i.e. the

distances d then follow one another irregularly.

Figure 19 shows a rope-like structure with a looped-back end. The end 65 has been looped through the openings 64, 64' and 64" and thus a loop has been formed which under tension has similar properties to those of spliced loops.

Figure 20 shows a part of a rope-like structure with cross sections. The opening 64 and the undivided areas 66' and 66" of the rope-like structure which border it are apparent. The opening 64 and the areas 66' and 66" include the cross sections A-A, B'-B' with cross section pictures A, B' and B". While the cross section pictures B' and B" indicate a round rope-like structure, for the cross section picture A a division and the resulting opening can be recognized.

Figure 21 shows a cord as a rope-like structure with openings arranged in a grid for low-slip strings. The structure of the cord or string corresponds roughly to Figure 18. It is however designed for smaller diameters of 0.8 - 2.0 mm. The first sections 70 with the openings 64, 64' and 64" are followed by second sections 71 in which the cord is present braided as an undivided, rope-like structure, or as a 'one-piece'. The sections 70 and 71 follow one another in a certain given grid. A second cord 73 is located perpendicular to the first cord 72 horizontally and has been looped through the opening 64 of the first cord. The length L of the openings or slots has been selected such that the traverse cord in the tensioned state lies roughly in the middle. Likewise, the length of the sections 70 and 71, i.e. the grid dimension, is matched primarily to the dimension of the slots and secondarily to the tension regions and the materials used. The grid fluctuates for example from 3-30 mm, i.e. the slots follow one another at these intervals.

The second core 73 is arranged essentially perpendicularly to the first cord 72. It adjoins it and forms part of the strings. But strings are also conceivable which allow the free spaces

between the cords to appear as lozenges.

These arrangements of cores or strings are suited for stringing of any type, for example for games which use balls such as tennis, badminton, squash or golf. Due to this arrangement the cords or strings can hardly move even under extremely high frictional pressure or impact pressure. In this way improved tensioning of the racket surface is achieved upon ball contact. The first and second cords are generally of identical structure, but this is not essential.

Figure 22 shows a cord with thickened areas arranged in a grid for low-slip strings. The cord structure corresponds roughly to Figure 21. The sections 70 and 71 follow one another in the first and second cords 74, 75 or strings. In the sections 71 the cord is made as an undivided rope-like structure, braided as a 'one-piece'. In sections 70 the cords have thickened areas 76 which are up to twice the diameter of the cord diameter in section 71. In this arrangement the lengths of the sections 70 and 71 and the grid size are matched to the tension ranges and the materials used. The grid fluctuates for example from 3-30 mm, i.e. the slots follow one another at these distances. The cords 74, 75 are essentially perpendicular to one another, in the tensioned state the middle regions of the sections 71 adjoining one another and forming part of the stringing.

These arrangements of cords or strings are suited for strings of any type, for example for games which use balls such as tennis, badminton, squash or golf. The cords or strings can only move insignificantly due to this arrangement even under extremely high frictional pressure and impact pressure. In this way improved tensioning of the racket surface is achieved upon ball contact. The first and second cords are generally of identical structure in this version, but this is not essential here either.

Core ropes claimed in the invention are used in industrial safety, in water sports, sailing and mountain climbing, and also in the police, fire department and military.

Ropes and cords claimed in the invention are used for recreation and hobbies, primarily as a replacement of braided or turned ropes.